LUCAS MAGIC: THE GENIUS BEHIND `JEDI'

The long-awaited third film in the "Star Wars" epic is here, pushing the use of special effects to new heights.

"IN George we trust," says a *Star Wars* fan in a behind-the-scenes documentary film. The comment, a mixture of reverence and fervent finger-crossing, speaks volumes about the intensity of anticipation awaiting George Lucas's third *Star Wars* movie, *Return of the Jedi.*

In George everyone trusts, not least the several hundred skilled special effects people who have laboured in Lucas's Industrial Light and Magic (ILM) studios to give reality to his vision. Judging by *Jedi's* reception in America, the trust seems well founded.

Special effects — EFX in film-making jargon — have been one of the stars of Lucas's multi-million blockbusters, as important to their success as Luke Skywalker, Han Solo or Darth Vader. In *Jedi* the emphasis is clear: a quarter of the $32 million budget went on effects and there are almost double the number that were used in *Star Wars,* the first film in a trilogy of which *Return of the Jedi* is the last.

At 39, George Lucas occupies a unique position in films. Personally enigmatic and retiring, he has flown in the face of Hollywood's monopoly and has established his own self-sufficient movie business. Sharing his vision and inspired by his meticulous attention to detail are perhaps the most gifted special-effects experts anywhere.

"There's not another ILM," said one of his team recently. "In terms of special-effects studios, nobody else has anything with as much money put into it, as many personnel or talented people in one place. It's like Walt Disney used to be when Walt Disney was alive. We're the best."

However, where Disney's magicians used pencil and paintbrush to achieve their animation, at ILM the tools of the trade are models, monsters and computer-controlled photography. For *Jedi* some 150 intricately crafted miniatures were built. Darth Vader's gigantic destroyer, eight kilometres long on screen, is in fact a three-metre model. In order to create the illusion of scale, the space ship was etched out of brass and more than 200,000 pinpoints of light were built into it.

The climax of the film is a chase down through the arteries of the Death Star, in and out of pipe-lined channels, finally into the reactor-core heart of the structure. During production, ILM built more than a football field's length of model tunnels, some of them 20 metres long.

Matting — a technique of shooting different ingredients in a picture against a blue screen and subsequently combining the images in the optical printing department — is the secret of the heart-stopping space battles against gyrating asteroids or spinning planets. The same method is often used when placing the live actors in gigantic sets: sometimes the sets themselves are no more than models.

Working on such a small scale requires infinite precision. Says one of Lucas's top operators, "It's so much harder to create convincing special effects when every slight flaw will be picked up by your average 10-year-old viewer. You can explain all day long the problems you've had getting the shots and it won't matter — all he or she is doing is going to the movies, and if you let them down, you've failed."

Creators of effects tend to think it inappropriate for the work they do to

The special effects team behind George Lucas's Jedi. *(This page) model-makers Paul Huston, Larry Tan and Barbara Gallucci prepare to do a test log-roll to establish timing. (Opposite page, top) the progress of the Vista Cruiser flying low over the Death Star is programmed by Richard Edlund. (Opposite page, bottom left) Don Dow, effects cameraman, prepares to program a shot of the Sail Barge. (Opposite page, bottom right) the Speeder Bike is a stunning effect in* Jedi; *cameraman Mike McAllister is building the model's mover.*

WHEN SEEING IS DISBELIEVING

J. Allen Hyneck is a world-renowned researcher into UFOs. Here, he questions commonly held beliefs on the subject.

WHETHER a person has complete disdain for UFO phenomena or completely uncritical acceptance, or takes one of the many intermediate positions, certain incontrovertible facts stand out. UFO reports not only exist but also persist; they flow from many parts of the world, from disparate cultures and environments. A significant percentage of such reports come from sane and responsible people.

UFO phenomena are one thing; their interpretation is quite another. Unfortunately, in the public mind one particular interpretation has completely overshadowed and displaced the phenomena themselves: UFOs have been made synonymous with visiting extraterrestrial intelligences.

Now this is a very appealing and exciting idea, but it is this very interpretation that has been an abomination to most scientists. Familiar as they are with awesome astronomical distances, they can see no logical way in which such visitors could get here. A simple illustration serves to emphasise this: if we let the thickness of an ordinary playing card represent the distance from the earth to the moon, then it would require a 30km line of playing cards, back to back, to reach the star closest to our solar system. If UFOs indeed be space visitors, then they must really know something we don't!

Here is the great stumbling block; here is where the baby is cast out with the bathwater: since, according to our present scientific paradigm, it is clearly impossible for space travel to exist on such a scale, well then, UFOs must be nonsense. This is a most logical deduction on the part of the well-meaning, objective members of the scientific fraternity.

Somehow this is reminiscent of the 19th century physicist who, while working with Crookes tubes (a prototypic cathode-ray tube), noted that protected photographic material became fogged when placed nearby. His far-reaching conclusion from this observation is said to have been "Do not place photographic materials near a Crookes tube," thus missing the discovery of X-rays.

Even the great can sometimes be found wearing blinkers when it comes to the unexpected. In his *Book of the Damned,* Charles Fort tells the following story of Antoine Lavoisier, one of the founding fathers of modern chemistry. On September 13, 1768, "French peasants in the fields near Luce heard a violent crash like a thunderclap and saw a great stone object hurtle down from the sky. The French Academy of Sciences asked the great chemist Lavoisier for a report on the occurrence; but Lavoisier was convinced that stones never fell out of the sky and reported that all the witnesses were mistaken or lying. It was not until the 19th century that the Academy accepted the reality of meteorites."

What might we be bypassing by overlooking UFO phenomena? Is our only possible conclusion that we should disregard them because their implications are so bizarre and are as unfathomable as X-rays would have been to the pedestrian, objective scientific worker of the 19th century? Perhaps it is a mistake to characterise observations of UFO phenomena as one 19th century British physicist defined effects produced by the hypnotists of his day: "One-half imposture and the rest bad observation." Today, these same hypnotic techniques are accepted and useful in many areas, from medical therapy to legal matters.

Now there is no doubt that many UFO reports are just as bizarre and unbelievable as the demonstrations of hypnotists or, to translate to the world of physics, as the seemingly unbelievable wave-particle duality of light. Indeed, the analogy is apt. UFO phenomena exhibit a similar duality, which, it seems, we must accept in a similar manner.

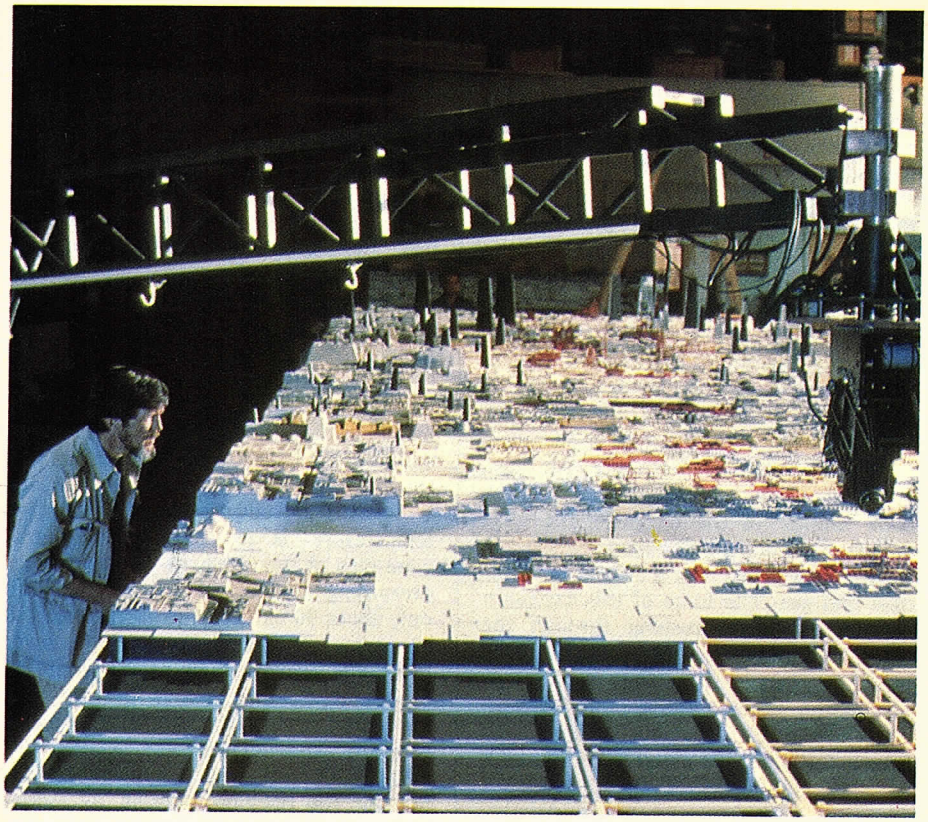
On the one hand, UFO phenomena seem to be utterly physical. Reported objects have been photographed (although it must be admitted that so far no really good close-ups have been produced), and they have appeared on radar screens. They can break tree branches and leave holes in the ground, and it is said that bullets have ricocheted off them. They have been reliably reported to stop car engines and to interfere with electrical circuits. A recent study of over 400 "car stopping" cases leaves little doubt about this physical effect.

Yet, on the other hand, UFO phenomena exhibit strangely nonphysical attributes. On occasion they appear, at least temporarily, to abrogate the inertial properties of matter; they exhibit extraordinary accelerations, hover effortlessly a few metres above the ground and can disappear before one's very eyes. Furthermore, physical objects can be kept track of. We always know where a bus or an aircraft is; it has a continuous "world line". But an outstanding characteristic of a UFO is its "localisation in space and time". A UFO is almost always reported in just one locality and is rarely seen sequentially in town after town, as a bus would be. And it does not remain for long in a specific locality. The distribution curve of UFO "duration times" peaks at about 10 minutes.

I have dubbed this unique property of the UFO the "Cheshire cat effect" after Alice's cat in Wonderland, which also appeared out of nowhere, remained in one location for a short period and then vanished!

John Stuart Mill, in his *A System of Logic,* noted, "The greatest of all causes of non-observation is preconceived opinion." To some, this ability of UFOs to appear and disappear is sufficient reason for dismissing the entire subject out of hand. But is this not more a case of refusing to look and observe because preconditioning teaches us to not want to look?

Turn to Page 22 for Australian author Bill Chalker's provocative views on the scientific "myopia" about UFO reports.



excite too much attention. The best effects are the least conspicuous — it's only after you've gone home from the movie that you should begin to think: *how did they DO that?* But ILM technicians also admit that there is mounting pressure to outdo themselves; audiences are more visually sophisticated and want to see new tricks.

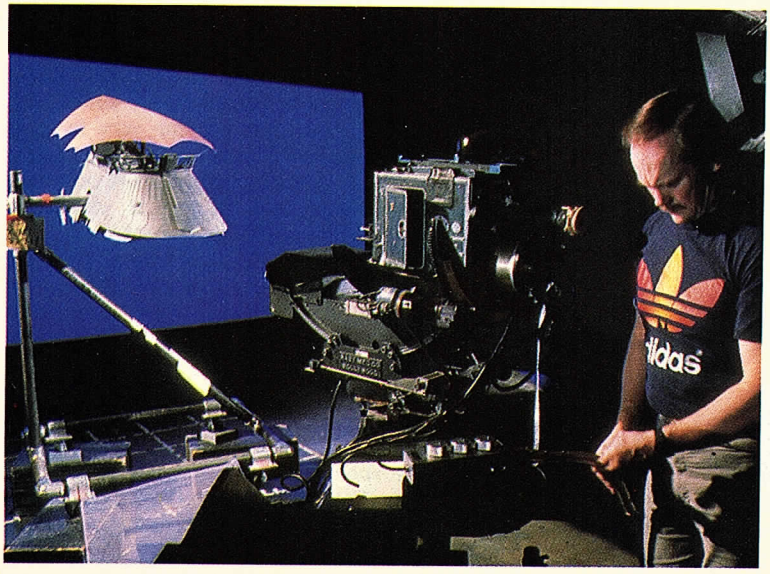
In this respect, *Jedi* pushes the limits further than ever before. ILM's "monster shop" was called on to create more than 60 extraterrestrial creatures.

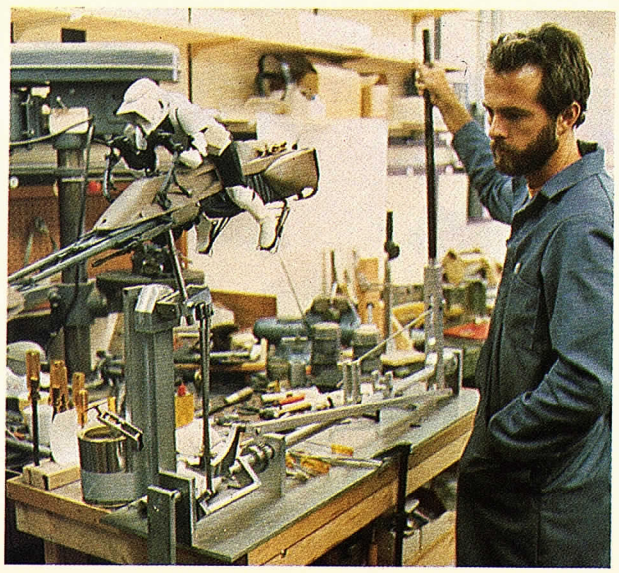
Says monster director Phil Tippett, "We did a lot of dreaming and closing our eyes, trying to imagine the most ridiculous creatures we could."

Imagining is one thing, making the ideas work is another. Some of the monsters were elaborately wired for electronic control, others were bizarre hand puppets like the Rancor Pit Monster, "a cross between a bear and a potato", according to Tippett. Again, size is deceptive with an apparently gigantic monster on screen created by a 45cm model.

With the first *Star Wars* trilogy completed, will there be more?

ILM's dedicated team would say so. Lucas himself, a modern magician, is too much in love with his own legerdemain to disagree.





NEW INSIGHTS ON THE UNIVERSE

Why is the cosmos made up of clumps; why is it not diffuse and shapeless through space?

By WALLACE TUCKER

WHY is the Universe so lumpy? Why is matter clumped together into galaxies, stars, planets and people and not spread evenly throughout the Universe?

The first step toward answering these questions is to understand that all matter in the Universe is in a state of dynamic tension between cause and chance, order and disorder. On the one hand, there is the law of averages, which operates everywhere, homogenising, scrambling, disordering. Examples of this principle, which is also known as the principle of maximum entropy or the second law of thermodynamics, are well known to all of us. A well-ordered deck of cards will get mixed up upon shuffling; a neat room will get messy if left to the mercy of a slovenly inhabitant; fumes from a cigar will spread throughout a room — and out into the street if we open the window.

Standing in opposition to the law of averages are *ordering* forces, forces that tend to bring matter together. These forces are gravity, electromagnetism and nuclear forces. Nuclear forces hold the smallest clumps of matter, the nuclei of atoms, together. Electrical forces hold together somewhat larger clumps, such as bacteria, people, rocks and icebergs. Gravitational forces bring together clumps the size of the earth or larger.

Whether a group of particles will form a clump or will disperse depends, then, on the relative strengths of the opposing tendencies toward disorder or order.

Against this background we can reconstruct a picture of the birth of our own "clump" of the Universe, the solar system. Four and a half billion years ago, a large star exploded near a diffuse cloud of dust and gas. The force of this explosion sent shock waves rushing through the cloud and compressed it, disturbing the balance between random-thermal (disorderly) motions and gravity (orderly). The end result was the collapse and fragmentation of the cloud into thousands of subclouds. One of these subclouds would finally become our solar system.

But what about another cosmic clump, the Milky Way — that magnificent spiral galaxy of several hundred billion stars, of which our sun is only one? How and when was it formed?

Among the most interesting of the various theories about the origin of our galaxy and others are those that seek to link the large-scale structure of the Universe to the laws that govern the smallest particles in the Universe.

These ideas are based on the Grand Unified Theories (GUTS, for short) — GUTS being a general term for theories worked out by a number of physicists, including Steven Weinberg, Abdus Salam and Sheldon Glashow. According to these theories, the complex structure of the Universe is a product of its prevailing low temperature. If temperatures on Earth were tens of thousands of degrees higher, everything here would be vaporised into only about 90 naturally occurring varieties of atoms. If the temperature rose to billions of degrees, these atoms would be broken down into quarks of one type (or colour) or another. Ultimately, according to the GUTS thinkers, at 100,000,000,000,000,000,000,000,000,000, or 100 octillion, degrees, all matter would be broken down into *one basic form.*

This, say some cosmologists, was the state of the Universe at some distant time. No stars or galaxies, not even any quarks or electrons or neutrinos. Of course, the Universe was not hot for very long. It quickly expanded and cooled — or *supercooled* — down toward absolute zero until it shattered into galaxy-size clumps of quarks, electrons and neutrinos. The energy generated in the shattering process was not enough to disperse the clumps, but it did heat the Universe again to very high temperatures, from which conditions the Universe as we know it evolved.

Whether these or some other ingenious ideas for explaining the lumpiness of the Universe will work out remains to be seen. We should know before the century is over. Then we can get on to the business of explaining the origin of the biggest clump around — our Universe itself.

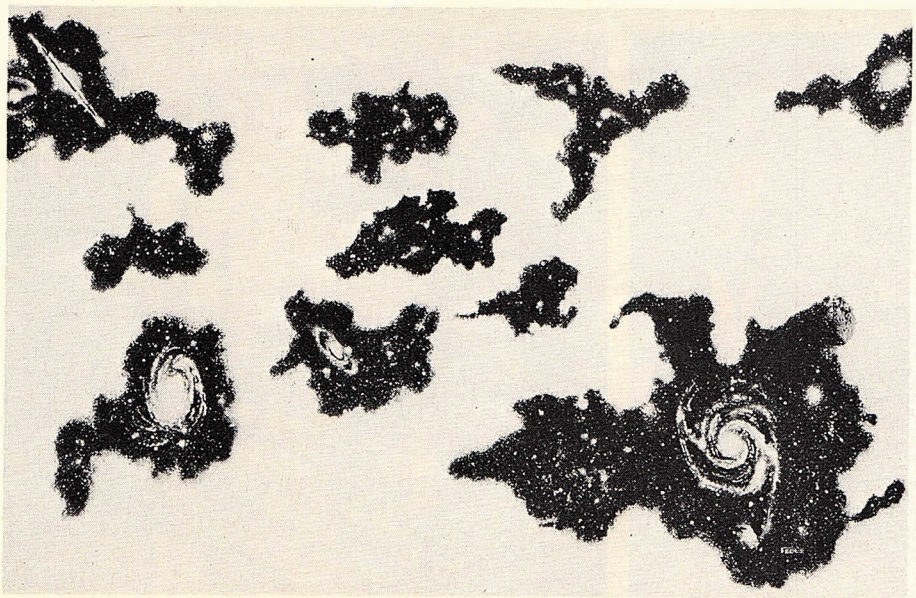


Illustration by Bohdan Fedus